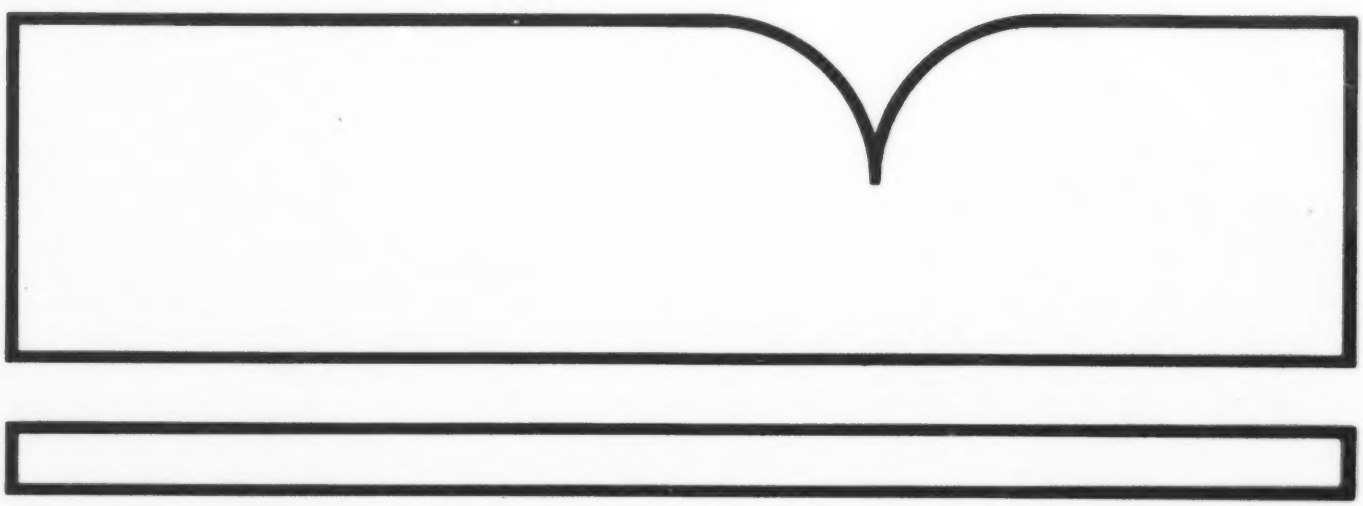
PB80-159577

Air Pollution Emissions Inventory Systems Appendix E. Emissions Inventory in Norway A Report of the NATO/CCMS Pilot Study on Air Pollution Assessment Methodology and Modeling

NATO Committee on the Challenges of Modern Society, Brussels (Belgium)

Jul 79



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16. ABSTRACT

This document is an appendix to report number 104; it gives a general overview of emissions inventory systems as well as methods used in Norway.

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OTAN CCMS

COMMITTEE ON
THE CHALLENGES OF
MODERN SOCIETY

AIR POLLUTION EMISSIONS INVENTORY SYSTEMS APPENDIX E EMISSIONS INVENTORY IN NORWAY

Number 104

NORTH ATLANTIC TREATY ORGANIZATION

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AIR POLLUTION EMISSIONS INVENTORY SYSTEMS

A Report of the NATO/CCMS Pilot Study
on Air Pollution Assessment Methodology and Modeling

No. 104, APPENDIX E

Air Pollution Emissions Inventory Systems
used in Norway

COMMITTEE ON THE CHALLENGES OF MODERN SOCIETY
NORTH ATLANTIC TREATY ORGANIZATION
(July 1979)

Preface

The North Atlantic Treaty Organization (NATO) established the "Committee on the Challenges of Modern Society" (CCMS) at the November 1969 meeting of the North Atlantic Council.

The CCMS was charged with developing meaningful environmental and social programs that complement other international programs, and with showing leadership, first, in solution of existing problems and, second, in development of long-range goals for environmental protection in the NATO sphere of influence and in other countries as well. A first Pilot Study on Air Pollution was initiated by the CCMS at its inaugural meeting in December 1969. The United States (Environmental Protection Agency) has been the pilot nation with the Federal Republic of Germany (Federal Ministry of the Interior) and Turkey (Scientific and Technical Research Council) as copilot-nations.

The Pilot Study on Air Pollution was an action program designed to demonstrate and encourage the utilization of existing knowledge for the development of air quality management programs. It entailed the demonstration of a system approach to air quality management. Case studies have been carried out in Ankara, Turkey; Frankfurt, Federal Republic of Germany; St. Louis, U. S.; Oslo, Norway; South Holland Region, The Netherlands (NATO/CCMS Report No. 6, Appendices A - E).

The results of the pilot study are documented in NATO/CCMS Report No. 6 (Revised) "Guidelines to Assessment of Air Quality" of October 1972 and in NATO/CCMS Report No. 33 (Final Report) containing 15 recommendations as well as in several other documents, listed as Annex II to this document.

Starting from three of the above recommendations (VI, VII and XIV) the Federal Republic of Germany proposed to initiate a new Pilot Study on Air Pollution Assessment Methodology and Modeling at the CCMS Plenary Session on October 22 and 23, 1974.

These NATO/CCMS Recommendations are:

RECOMMENDATION VI

Member nations will co-operate to develop standardized methods for emissions data storage and retrieval to support requirements in the conduct of national air quality management programs. The US National Emission Data System (NEDS) might serve as a model for a common international system.

RECOMMENDATION VII

Member nations will co-operate to develop standardized techniques for projecting emissions and predicting future ambient air quality.

RECOMMENDATION XIV

Member nations agree the CCMS modeling activity has shown that there is a widespread need for further international co-operation to accomplish the following tasks:

Bring together model developers and air quality managers for exchange of ideas, discussion of users' needs and demonstration of modeling techniques.

Standardize modeling techniques for specific air quality management applications and consider how computerized models might be made available for all users.

Continue to review on-going air quality assessment studies.

In spring 1975 the North Atlantic Council approved the German proposal. The pilot study work started with the Federal Republic of Germany (Federal Ministry of the Interior) as pilot nation and the United States of America (Environmental Protection Agency) and Belgium (Service du Premier Ministre) as co-pilot nations:
A Working Group and two Panels were established with the following functions:

Assessment Methodology Panel

- Pursue and carry out Recommendations VI and VII
- Continue to review present and future assessment studies with respect to the application of assessment methodology.

Modeling Panel

- Develop standardized models for various air quality management applications.
- Develop programs to improve modeler/user communications in conjunction with the Assessment Methodology Panel and the Working Group.
- Continue as an information forum on new modeling concepts and techniques, organizing once a year international technical meetings on air pollution modeling and its application.

In addition the Working Group established an Ad-Hoc Group on Air Quality Management Systems to revise and update the NATO/CCMS Report No. 6 (Revised) 1972 by preparing a new document on "Guidelines to Air Quality Management Systems".

Another Ad-Hoc Group was set up for compiling a Glossary of Terms frequently used in assessment methodology, modeling and air quality management systems.

As an outcome of this Pilot Study on Air Pollution Assessment Methodology and Modeling the following NATO/CCMS documents are published (see also Annex III):

Air Quality Management System

- Guidelines to Air Quality Management System.

Assessment Methodology

- Air Pollution Emissions Inventory Systems
- Air Pollution Emissions Projecting

Air Pollution Modeling

- Introduction to Air Quality Modeling
- Uses and Needs for Air Quality Modeling
- Bibliography on Grey Literature on Air Quality Modeling, Part I (Applied Models)
- Bibliography on Grey Literature on Air Quality Modeling, Part II (New Modeling Techniques)
- Practical Demonstration of Multiple Source Urban Air Quality Modeling (Gaussian Plume)
- Fundamentals for the Applications of a Gaussian Plume Model

Other Publications

- Glossary of Terms
- Proceedings of the 6th to 9th International Technical Meetings on Air Pollution Modeling and its Application
  (6th Meeting, 24. - 26. Sept. 1975, Frankfurt/Main, Germany)
  (7th Meeting, 7. - 10. Sept. 1976, Airlie House, USA)
  (8th Meeting, 20. - 23. Sept. 1977, Louvain-la-Neuve, Belgium)
  (9th Meeting, 29. - 31. Aug. 1978, Toronto, Canada).

The chairman of the Working Group wishes to acknowledge the scientists participating from pilot, copilot, and observer countries, and the many other persons, who assisted in the preparation of this document.

The panel, which performed diligently throughout the course of this effort, receives the highest praise. The panel members were:

Federal Republic of Germany - Pilot Country

F. Gerold
H. Meinl
K. E. Joerss

Belgium - Copilot Country

R. Dams
C. de Wispelaere

United States of America - Copilot Country

R. Baumann
J. R. Hammerle
J. Bosch

Canada - Observer

P. J. Choquette

France - Observer

W. Challemel du Rozier

Norway - Observer

O. I. Skogvold

The Netherlands - Oberserver

L. H. J. Wachters.

The addresses of the panel members are listed in Annex I.

Full recognition is given to each panel member for carrying out and coordinating review and other activities related to the development of this document in his respective country and to Ms. C. Morawa of the Federal Environmental Office, Germany for her effort in coordinating and organising and for editorial work.

For the Working Group,
Erich Weber, Chairman.

The present document is an appendix to the NATO/CCMS document

AIR POLLUTION EMISSIONS INVENTORY SYSTEMS

No. 104, October 1978

which gives a general overview of the matter of emissions inventory systems as well as of the methods currently applied in BELGIUM, CANADA, the FEDERAL REPUBLIC OF GERMANY, The NETHERLANDS, NORWAY and the UNITED STATES OF AMERICA.

It contains documentations of air pollution emissions inventory systems currently used in

Belgium	Appendix A
Canada	Appendix B
Germany, F. R.	Appendix C
The Netherland	Appendix D
Norway	Appendix E
United States	Appendix F

Each appendix is bound as a separate volume

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Emissions Inventory Techniques

1. Introduction

A nation-wide inventory of pollutant emission and sources is a necessary part in the efforts of maintaining acceptable quality of the environment and in controlling pollution sources. An emissions inventory should contain information, which enables the appropriate authorities to identify the problem and set priorities on control strategies. The information should list all emission sources, as to their nature and location, and identify the types and quantities of pollutants emitted from each source.

In Norway the first comprehensive emissions inventory was undertaken by Norges Industriforbund (NIF) (The Federation of Norwegian Industries). Data were collected on all gaseous, liquid, and solid wastes which could reach the "recipients", i. e. the air, water, and soil. Supplementary data on fuel oil consumption in Norway were collected by the oil companies.

In addition to these efforts, emission data have also been gathered by the Norwegian Institute for Air Research (NILU), Institute for Transportation Economics (TØI), State Technological Institute (STI), and the Environmental Laboratory of Lower Telemark (Kontrollaboratoriet for Nedre Telemark). Most of these data have been published in "Specialanalyse I Forurensninger" by the Department of Finance.

All of these basic data have been used to compile a number of emissions inventories on specific air pollutants. (Most of this further work has been carried out by NILU.) In this regard, SO_2 and particulates have received the most attention, but inventories of nitrogen oxides and hydrocarbons have also been made.

Based on the collected data, surveys of the emissions and their implications have been calculated. The initiative to this was taken by the Ministry of Finance. Under the Ministry of Environment the emission authority (SFT) has made emission surveys of specific industrial processes and has proposed guidelines for maximum allowable emissions from these.

2. Methodology

The Federation of Norwegian Industries, which represents a cross-section of most of the trades, businesses, and industries in Norway, began its investigations in 1971. A questionnaire (see Addendum I) was sent out to some 1500 industrial establishments. From the information received (which was supplemented by selected interviews) and the data supplied by the oil companies, an inventory of SO_2-emissions was compiled.

Various organizations have now made use of this information.

In the OECD-project "Long Range Transport of Air Pollutants" (NILU) the SO_2 contributions of the various countries were allocated according to a grid net. Each grid square of the net had the size 1/2 degree latitude by 1 degree longitude, and was identified by the coordinates of its lower left corner. Thus, for example, a grid square in Norway between 59.0° and 59.5° latitude and 10° and 11° longitude would be labelled (59.0, 10) and have an area of 55 km x 55 km, or approximately 3000 km^2.

Norway was divided into approximately 140 grid squares. By summing up one finds that 62 squares have SO_2-emissions less than 1000 metric tons SO_2/year. From 4 grid squares SO_2-emissions are greater than 10000 metric tons/year.

In a more detailed emissions inventory (NILU), the SO_2-emissions were divided into:

a) continuous emissions, and
b) variable emissions,

which were defined as follows:

A "continuous emission" is one for which the emission rate is approximately constant from week to week over a whole year. Most emissions from industrial processes and operations fall into this category. "Variable emissions" include emissions from seasonally-operated industries, and those from commercial and domestic heating which are largely ambient temperature dependent. Domestic heating contributions were estimated from the number of inhabitants in each grid square and degree days.

This inventory was further refined by separating SO_2-emissions due to combustion of fossil fuels from those resulting from various industrial processes. The emission per inhabitant per km^2 and year was also calculated. The data for this study came from the aforementioned industrial survey questionnaire and interviews, oil company fuel sales records, and population growth statistics supplied by the Central Bureau of Statistics of Norway.

A number of emissions inventories have been made for specific types of industries in Norway (NIF). These give the total amounts of the most important air pollutants emitted from the industrial processes and operations in question.

A special emissions inventory has been compiled for the sources of oxides of nitrogen and hydrocarbons (NILU). The emissions from the combustion of gasoline (petrol) and fuel oil have been calculated from sales statistics of oil companies, while information on industrial processes was obtained mainly through direct contacts with the industries concerned. Since most of the available data represented nation-wide totals, the emissions of the various source categories were also first calculated for the entire country.

Four main source categories were used:

1) Mobile sources
2) Stationary sources
3) Industrial sources
4) Miscellaneous sources.

Each of these were further subdivided as follows:

1) Mobile sources:

   a) air transport (based on take-off, landing, taxiing, fuelling)

   b) road transport (based on sales of gasoline, diesel fuel, traffic counts)

   c) railways (based on sales of diesel fuel, mileage statistics)

   d) shipping (based on sales of diesel fuel, fuelling statistics)

2) Stationary sources:

   a) power stations (no thermal power stations in Norway)

   b) industrial oil combustion (based on sales, statistics, EPA emission factors)

c) domestic and commercial heating (based on sales statistics, EPA emission factors)

3) Industrial processes:

a) oil refineries (based on information from the refineries, EPA emission factors)

b) petrochemical industries (none at the moment in Norway)

c) asphalt production (based on information from the producers)

d) nitric acid production (based on information from the producers)

4) Miscellaneous sources:

forest fires, gasoline service stations etc. (no data available at this time).

Separate calculations on the emissions of oxides of nitrogen and hydrocarbons have been made for three selected grid squares where the formation of secondary, photochemically-produced air pollutants was considered to be a possibility (see Addendum II). The sources in this inventory were categorized in the same manner as above. The emissions of oxides of nitrogen and hydrocarbons in these three grid squares amount to 34 % and 22 %, respectively, of the total emissions for the country. Although the area of the three squares represents only about 2.5 % of the country, it contains 28 % of the population of Norway.

Two special emissions inventories have been compiled for much smaller grid squares of 1 km by 1 km. One of these is for SO_2-emissions in the Oslo area (for details see Appendix D to NATO/CCMS Air Pollution Doc. No. 6).

The other is for the Skien/Porsgrunn area (J. Schjoldager's model) where rather good information on emissions of a number of air pollutants (based on actual stack tests and material balance calculations) is available. Reliable immission and meteorological measurement data have also been accumulated for this area.

NORWEGIAN INSTITUTE FOR AIR RESEARCH
P.O. BOX 115, N-2007 KJELLER, NORWAY

CONTENTS OF THE QUESTIONAIRE

MADE BY

THE FEDERATION OF NORWEGIAN INDUSTRIES

TRANSLATED INTO ENGLISH

1. Name of company: _____
   Address : _____
   Postal district: _____
   Country : _____

2. In case further information is needed, please contact: _____
   _____
   Telephone no.: _____

3. Category of company and classification in central Bureau of Statistics: _____
   _____

4. Number of employees: _____

5. The company's consumption of mineral oils:

5.1 Fuel oil, type : _____ ton per year: _____
   Fuel oil, type : _____ ton per year: _____
   Fuel oil, type : _____ ton per year: _____

5.2 Lubricating oils: _____ ton per year: _____

5.3 Other mineral oil products:

Name: _____ ton per year: _____
Name: _____ ton per year: _____
Name: _____ ton per year: _____

6. The company's consumption of water: _____ m^3/year

6.1 Distribution of water consumption:

Production department/process	m^3/year	Of this as cooling water only, m^3/year

7. Consumption of raw materials and chemicals which results in or can result in waste (e.g. metals, salts, organic acids, tri- and tetrachlor-ethylene, carbon tetrachloride and other halogenated hydrocarbons, other solvents, paints and lacquers, specific additives, pharmaceutical products, pesticides etc.).

Name and/or chemical composition	Quantity per year

8. The company's production line

Type of goods	Production method	Quantity per year	Gross production value	Type of waste from the production. (Quantity to be indicated under post 9).

9.1 Waste products released to air (solid particles, aerosols, gases).

Name and/or chemical composition	Quantity per year	Distinguishing characteristic

9.2 Waste products which are led to public sewage (compounds mentioned under posts 5 and 7, - raw materials, subsidiary products and output). (Waste products released to water-course or sea: cfr. post 9.3).

Name and/or chemical composition	Quantity per year	Distinguishing characteristic

9.3 Waste products which are destroyed by the company

Name and/or chemical composition	Quantity per year	Distinguishing characteristic

9.6 Waste products which are thrown away on a garbage heap (compounds mentioned under posts 5 and 7, - waste oil, plastics, wrapping of wood, metal and plastic, leftovers of paints and lacquers, printers ink, metal waste, cotton waste and paper soiled with compounds mentioned under posts 5 and 7 etc. Specify as accurately as possible.)

Name and/or chemical composition	Quantity per year	Distinguishing characteristic

9.7 Waste products which are thrown away to watercourse or sea (specify as under post 9.6).

Name and/or chemical composition	Quantity per year	Distinguishing characteristic

10. Is there any intention by the company to cause modifications to be done, which can change the quantity or the composition of the waste products? _____

_____

Which? _____

_____

11. Further information, which might be of value for the study

_____

_____

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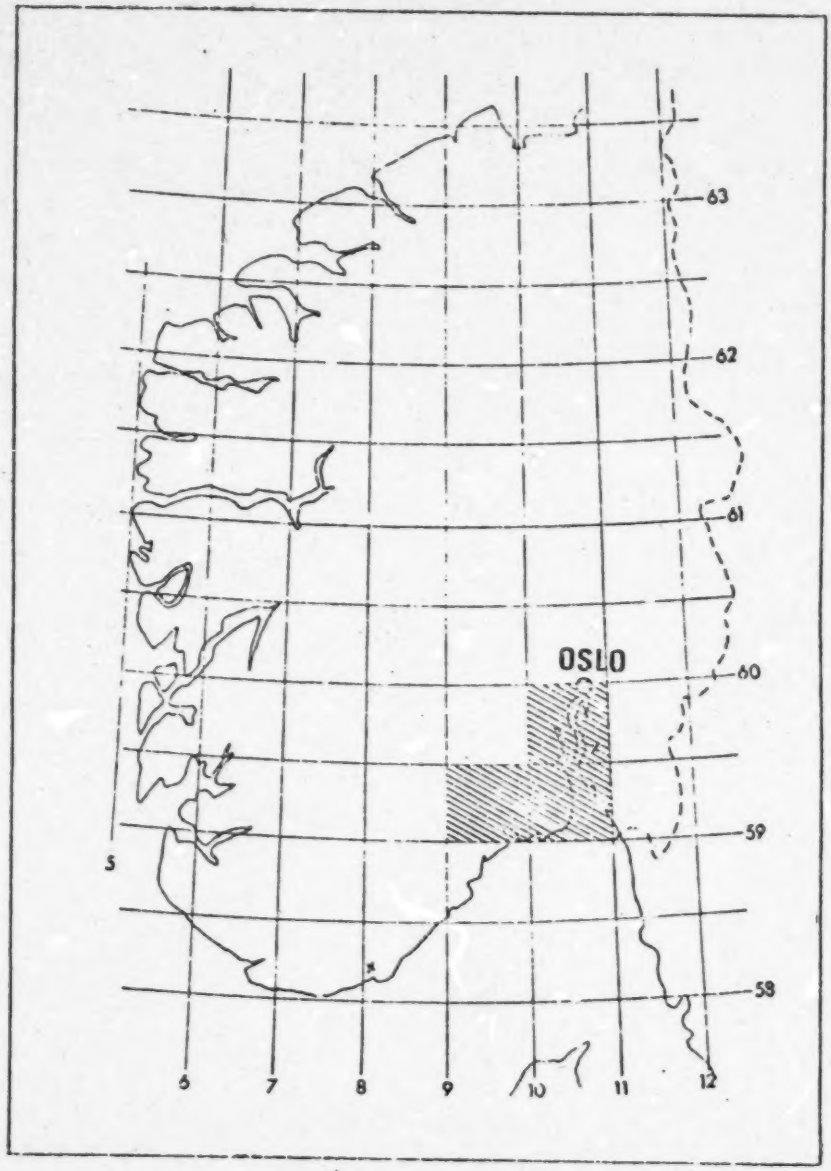
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ANNEX I

Names and Addresses of Panel Members (as of Fall 1978)

R. D. Bauman	Environmental Protection Agency (OAQPS - SASD - ESB - MD - 12) Research Triangle Park USA - 27711 North Carolina
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ANNEX II

NATO/CCMS Documents on the First Air Pollution Pilot Study (available at: NATO/Committee on the Challenges of Modern Society, NATO Headquarters, Brussels, Belgium)

AIR POLLUTION (No. 5)

Proceedings of the 2nd Meeting of the Expert Panel on Air Pollution Modeling, (26 - 27 July 1971, Paris, France). Out of stock

AIR POLLUTION (No. 6)

Guidelines to Assessment of Air Quality (Revised)

APPENDIX A	Assessment of Air Quality in Ankara (February 1973)
APPENDIX B	Assessment of Air Quality in St. Louis (February 1973)
APPENDIX C	Assessment of Air Quality in Frankfurt (June 1974)
APPENDIX D	Assessment of Air Quality in Oslo (February 1973)
APPENDIX E	Assessment of Air Quality in the South Holland Region (December 1973)

AIR POLLUTION (No. 7)

Quality Criteria for Sulphur Oxides (November 1971). Out of stock

AIR POLLUTION (No. 8)

Air Quality Criteria for Particulate Matter (November 1971). Out of stock

AIR POLLUTION (No. 10)

Air Quality Criteria for Carbon Monoxide (June 1972)

AIR POLLUTION (No. 12)

Control Techniques for Sulphur Oxide Air Pollutants (October 1973)

AIR POLLUTION (No. 13)

Control Techniques for Particulate Air Pollutants (October 1973)

AIR POLLUTION (No. 14)

Proceedings of the 3rd Meeting of the Expert Panel on Air Pollution Modeling (2 - 3 October, 1972, Paris)

AIR POLLUTION (No. 15)

Air Quality Criteria for Nitrogen Oxides (June 1973)

AIR POLLUTION (No. 18)

Control Techniques for Carbon Monoxide Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 19)

Control Techniques for Hydrocarbon and Organic Solvent Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 20)

Control Techniques for Nitrogen Oxide Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 29)

Air Quality Criteria for Photochemical Oxidants and Related Hydrocarbons (February 1974)

AIR POLLUTION (No. 30)

Proceedings of the 4th Meeting of the Expert Panel on Air Pollution Modeling, (28 - 30 May 1973, Oberursel, Germany)

AIR POLLUTION (No. 33)

Final Report (May 1974)

AIR POLLUTION (No. 35)

Proceedings of the 5th Meeting of the Expert Panel on Air Pollution Modeling (4 - 6 June 1974, Roskilde, Denmark)

AIR POLLUTION (No. 41)

First Follow-up Report (December 1975)

AIR POLLUTION (No. 50)

Second Follow-up Report (December 1976)

AIR POLLUTION (No. 67)

Third Follow-up Report (November 1977)

AIR POLLUTION (No. 96)

Fourth Follow-up Report (October 1978)

AIR POLLUTION (No. 6, Appendix C revised)

Assessment of Air Quality in Frankfurt (December 1977)

ANNEX III

NATO/CCMS Documents on the Pilot Study on Air Pollution Assessment Methodology and Modeling
(available at: NATO/Committee on the Challenges of Modern Society, NATO Headquarters, Brussels, Belgium)

Air Pollution (No. 42)

Proceedings of the 6th International Technical Meeting on Air Pollution Modeling and its Application
(24 - 26 September 1976, Frankfurt/Main, Germany)

Air Pollution (No. 51)

Proceedings of the 7th International Technical Meeting on Air Pollution Modeling and its Application
(7 - 10 September 1976, Airlie House, USA)

Air Pollution (No. 70)

Bibliography on Grey Literature on Air Quality Modeling, Part I (Applied Models) (October 1977)

Air Pollution (No. 71)

Air Quality Management Systems (AQMS) (October 1977)

Air Pollution (No. 88)

Bibliography on Grey Literature on Air Quality Modeling, Part II (New Modeling Techniques) (October 1978)

Air Pollution (No. 89)

Glossary of Terms Generally Used in Air Pollution Assessment Methodology and Modeling (October 1978)

Air Pollution (No. 80)

Proceedings of the 8th International Technical Meeting on Air Pollution Modeling and its Application
(20 - 23 September 1977, Louvain-la-Neuve, Belgium)

Air Pollution (No. 99)

Introduction to Air Quality Modeling (October 1978)

Air Pollution (No. 100)

Air Pollution Emissions Projecting (October 1978)

Air Pollution (No. 101)

Uses and Needs for Air Quality Modeling (May 1979)

Air Pollution (No. 102)

Fundamentals for the Application of a Gaussian Plume Model
(April 1979)

Air Pollution (No. 104)

Air Pollution Emissions Inventory Systems
(October 1978/July 1979)

APPENDIX A: Emissions Inventory in Belgium
APPENDIX B: Emissions Inventory in Canada
APPENDIX C: Emissions Inventory in Germany, Federal Republic of
APPENDIX D: Emissions Inventory in The Netherlands
APPENDIX E: Emissions Inventory in Norway
APPENDIX F: Emissions Inventory in the United States of America

Air Pollution (No. 106)

Practical Demonstration of Multiple Source Urban Air Quality Modeling (Gaussian Plume) (August 1979)

Air Pollution (No. 71, Revised)

Air Quality Management Systems (AQMS) (April 1979)

Air Pollution (No. 105)

FINAL REPORT (October 1979)

Air Pollution (No. 103)

Proceedings of the 9th International Technical Meeting on Air Pollution Modeling and its Application
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Air Pollution (No. 108)

Proceedings of the 10th International Technical Meeting on Air Pollution Modeling and its Application
(23 - 26 October, 1979, Roma, Italy)